82d Congress, 2d Session - - - - - House Document No. 397

QUEEN CREEK WATERSHED
ARIZONA

LETTER

FROM

ACTING SECRETARY
DEPARTMENT OF AGRICULTURE

TRANSMITTING

A SURVEY REPORT DATED JULY 1950, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, OF THE QUEEN CREEK WATERSHED IN ARIZONA MADE UNDER THE PROVISIONS OF THE FLOOD CONTROL ACT APPROVED JUNE 22, 1936, AS AMENDED AND SUPPLEMENTED

MARCH 20, 1952.—Referred to the Committee on Public Works and ordered to be printed with illustrations

---

UNITED STATES
GOVERNMENT PRINTING OFFICE
96904 WASHINGTON : 1952

LETTER OF TRANSMITTAL

DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, March 10, 1952.

The SPEAKER, HOUSE OF REPRESENTATIVES.

Dear Mr. SPEAKER: I am submitting herewith a survey report dated July 1950, together with accompanying papers and illustrations, of the Queen Creek watershed in Arizona made under the provisions of the Flood Control Act approved June 22, 1936, as amended and supplemented.

I recommend that the Secretary of Agriculture be authorized to carry out the program of runoff and waterflow retardation and soil erosion prevention proposed in this report.

Enclosed are comments received from the Governor of Arizona and interested Federal agencies.

The Bureau of the Budget, in its letter of February 25, 1952, advises that there is no objection to the submission of this report to the Congress. The Bureau further advises that it is in agreement with the objective contemplated in the report of carrying out measures designed to retard floods and prevent soil erosion, and that this objective is particularly desirable from the point of view of coordination of upstream measures with the flood-control programs of the Corps of Engineers. A copy of the letter from the Bureau of the Budget is enclosed.

Sincerely,

K. T. HUTCHINSON,
Acting Secretary.

QUEEN CREEK WATERSHED, ARIZONA

LETTER FROM THE BUREAU OF THE BUDGET TO THE SECRETARY OF AGRICULTURE

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
Washington 25, D. C., February 25, 1952.

The honorable the SECRETARY OF AGRICULTURE.

MY DEAR MR. SECRETARY: This will acknowledge receipt of Acting Budget Officer John Wells' letter of May 2, 1951, requesting advice as to the relationship to the President's program of the proposals contained in your Department's report, dated July 1950, entitled "Survey Report, Queen Creek Watershed, Arizona."

Floodwater and sediment damages occurring in the Queen Creek watershed are estimated to average $152,700 annually. The principal losses, estimated to average $116,600 annually, are caused by flooding of agricultural crops, land, and irrigation works. Floods also cause damage to highways, urban property, railroads, reservoir areas, recreation, aquatic life, and public health.

It is proposed to alleviate these damages and to realize extensive associated benefits by installing a number of interrelated and interdependent soil and water conservation and control measures during a 10-year period. These measures, applied in proper combination with other soil and water conservation practices and measures, would constitute a basic system of soil and water conservation in accordance with needs and capabilities of the land in the Queen Creek watershed. Educational assistance and technical services are also recommended as a part of the proposed program.

The estimated cost of the recommended program, based on 1948 prices, is $1,348,000. The Federal Government would be expected to expend $1,107,400 of the total cost; and local interests would contribute $240,600 or its equivalent in labor, materials, equipment, land easements, and other assistance in lieu of cash payments. Operation and maintenance of the recommended works of improvement are estimated to cost $20,290 annually, of which the Federal Government would provide $860, and $19,430 would be borne by landowners and local interests.

It is estimated that the recommended watershed program, if installed as planned and maintained adequately, will yield average annual benefits evaluated at $151,660. These benefits may be grouped under two categories—flood-control benefits, amounting to $143,260; and conservation benefits, totaling $8,400. The flood-control benefits, which are derived chiefly from floodways and a floodwater retard structure, consist of floodwater damage reductions to crops, irrigation works, roads, railroads, and other property. The conservation benefits

would result mainly from the provision of farm waterways, terraces, pasture development, and other conservation measures.

The total average annual costs are estimated at $55,662. Since prices are expected to vary during the 10-year installation period, both benefits and costs were adjusted to anticipate future price levels by applying indexes provided by the Bureau of Agricultural Economics. The effect of this adjustment or alternate evaluation is to reduce monetary values of both benefits and costs. Thus, the average annual benefits are adjusted to $88,670 and the costs, on the same basis, to $42,780. This adjustment results in a revised benefit-cost ratio of 2.1 to 1.0 for the recommended program.

The report has been reviewed by the Governor of Arizona and also by the several concerned Federal agencies, in accordance with policies and procedures for distribution and coordination of reports as adopted by the Federal Inter-Agency River Basin Committee. The views expressed are generally favorable to the proposed program, with suggestions limited to considerations that could be resolved cooperatively by the concerned agencies or local interests during the periods of planning and installing the watershed works of improvement.

The work envisioned in the report is constituted principally of floodways, floodwater retard structures, and stabilizing and sediment-control structures. The program recommended also includes an intensification, acceleration, and adaptation of range land treatment activities already in progress under going programs of the Department of Agriculture. These include such programs as the conservation and use program, authorized by the Soil Conservation and Domestic Allotment Act, approved February 29, 1936, as amended; and the Soil Conservation Service's program of assistance to districts and other cooperators, authorized by the act of April 27, 1935.

The Bureau of the Budget is in agreement with the objective contemplated in the report of accelerating land treatment measures and installing structural measures designed to retard floods and prevent soil erosion. This objective is particularly desirable from the point of view of coordination of upstream measures with the flood-control programs of the Corps of Engineers.

The measures contemplated to implement the proposed program may be grouped into two broad categories—land treatment measures and structural measures. The Bureau of the Budget is of the opinion that installation of the structural measures (shown in table 2, p. 21, of the report as "Floodways," "Floodwater retard structure," and stabilizing and sediment-control structures included under "Land treatment measures") should properly be authorized under the flood control act, as amended and supplemented. The Bureau also believes that the land-treatment measures set forth in the report, since they are largely an acceleration of existing programs of the Department of Agriculture, should be financed under appropriations other than that for the Flood Control Act. This would avoid confusion in the presentation of the Department's budgetary program, since many of the current land treatment programs of the Department have the objective of runoff and waterflow retardation and the prevention of soil erosion. To the extent that the acceleration of land treatment measures under existing authorities is not possible, we urge that adequate authorities for such acceleration be sought through amendment of those basic authorities.

Your staff, on the other hand, believes that the Department cannot properly meet its responsibilities under the Flood Control Act unless the full program envisioned in the report is authorized under that act. Your representatives, however, agreed that appropriations for land treatment phases implementing the program recommended in the report, upon approval by the Congress generally on the basis as submitted, would be sought as additions to going program appropriations of the agencies carrying on the work. Funds for structural works or measures would still be requested under the appropriation "Flood control." The total obligations for land treatment and structural measures in each authorized flood-control project area could, of course, be shown in a summary table to be presented in the program and performance section of the annual Budget Document.

Subject to the above understanding as to the method of presenting the budget for flood control programs, there would be no objection to the submission of the proposed Queen Creek watershed flood-control survey report to the Congress. In the event the report or any modification thereof is approved by the Congress, submission of requests for appropriations must be justified in accordance with the policy set forth in the President's letter of July 21, 1950, which directed that all civil public works be considered with the objective, as far as practicable, of deferring, curtailing, or slowing down those projects which do not directly contribute to national defense or to civilian requirements essential to the changed international situation, or as may later be modified.

In submitting the Department's report to the Congress, it will be appreciated if you include a copy of this letter.

Sincerely yours,

ELMER B. STAATS,
Assistant Director.

LETTER FROM THE CHIEF OF ENGINEERS TO THE SECRETARY OF AGRICULTURE

DEPARTMENT OF THE ARMY,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, September 24, 1951.

The honorable the SECRETARY OF AGRICULTURE.

DEAR MR. SECRETARY: Reference is made to the survey report on Queen Creek watershed, Arizona, of the Department of Agriculture, transmitted to this office for comment.

The report recommends that the Federal Government undertake a program for runoff and waterflow retardation and soil-erosion prevention for the Queen Creek watershed to provide for reduction of floodwater and sediment damage, conservation of soil and water resources, and the establishment of a permanent and stable agriculture. The program includes construction of (1) approximately 30 miles of minor floodways, (2) a floodwater retard structure, and (3) approximately 310 stabilizing and sediment-control structures; and the improvement of approximately 318,000 acres of range land. The total cost of the program is estimated at $1,348,000, of which the Federal cost would be $1,107,400.

Pursuant to act of Congress approved 24 July 1946, the Corps of Engineers is authorized to construct a flood-control and water-conservation reservoir at Whitlow Ranch, Arizona, at an estimated first cost of $1,645,000. The Department of Agriculture's program was planned with cognizance of and supplmentary to the planned improvement of the Corps of Engineers. It appears from statements made in the report that there has been no duplication of the benefits accredited to the plans of the two agencies. It is noted further that the reduction in erosion of the lands above the reservoir as effected by the improvements proposed in your report would prolong the useful life and increase the flood-control effectiveness of the Whitlow Ranch reservoir.

The design capacities of the floodway channels appear adequate to obtain an effective measure of control of runoff from the area. With reference to the floodwater retard structure, which is an earth dike 2 miles in length and varying from 1 to 20 feet in height, I feel that the information presented does not permit a determination as to the adequacy of design capacity or estimated cost. I understand, however, that you contemplate a detailed reinvestigation of the engineering adequacy, cost, and economic value of this structure prior to requesting construction funds, in the event that the program is authorized by Congress.

I am pleased to advise you that the improvements contemplated in your report will not conflict with any improvement for flood control in the Queen Creek Basin under consideration at this time by the Department of the Army, and that the erosion control measures above the authorized Whitlow Ranch reservoir will enhance its effectiveness.

The opportunity to review your report is appreciated.

Sincerely yours,

LEWIS A. PICK,
Lieutenant General, Chief of Engineers.

LETTER FROM THE GOVERNOR OF ARIZONA TO THE SECRETARY OF AGRICULTURE

OFFICE OF THE GOVERNOR,
STATE HOUSE,
Phoenix, Ariz., April 10, 1951.

Mr. CHARLES F. BRANNAN,
Secretary, Department of Agriculture,
Washington, D. C.

DEAR SECRETARY BRANNAN: My sincerest apologies for the long delay in replying to your letter of September 6 addressed to the Honorable Dan E. Garvey, former Governor of Arizona.

Your letter requested comments on a Department of Agriculture survey report on the Queen Creek watershed here in Arizona.

By and large, we concur in the report as to its recommendations and specifications and pledge whatever cooperation may be possible from this end. Unfortunately, for complete fulfillment of participation there must be a sponsoring agency. As you may or may not know, there is no provision for a flood-control district, and apparently

there is no ready means for assigning this responsibility to any agency in particular.

It has been suggested that perhaps the county could accept temporary responsibility, but so far we have not been able to verify this fact.

Any suggestions you may have will be gratefully received.

Sincerely,

HOWARD PYLE, *Governor.*

LETTER FROM THE ASSISTANT SECRETARY OF THE INTERIOR TO THE SECRETARY OF AGRICULTURE

DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington 25, D. C., December 22, 1950.

Hon. CHARLES F. BRANNAN,
Secretary of Agriculture,
Washington 25, D. C.

MY DEAR MR. SECRETARY: In accordance with Federal Inter-Agency River Basin procedures, you transmitted by letter dated September 6, 1950, for the information and comments of the Department, copies of the Department of Agriculture's survey report on the Queen Creek watershed, Arizona.

The report outlines a program of runoff and waterflow retardation and soil erosion prevention in Queen Creek watershed, Arizona, and presents recommendations for its installation and maintenance. A 10-year program is recommended at a total estimated cost of $1,348,000. It includes the construction of approximately 30 miles of minor floodways of relatively small diversions to collect and divert runoff water from plains areas to effective channels; one floodwater retard structure to regulate runoff released from the system of floodways; approximately 310 stabilizing and sediment control structures, including desilting areas; and improvement of approximately 318,000 acres of range land. The average annual value of the total benefit is given as approximately $152,000 and the average annual value of the total cost of the recommended program about $56,000.

In accordance with Federal Inter-Agency River Basin Committee procedures, the report was reviewed by regional personnel of the Bureau of Reclamation, Bureau of Mines, Bureau of Indian Affairs, Geological Survey, Bureau of Land Management, and Fish and Wildlife Service. Opportunity for such review is appreciated.

The Department recognizes that many problems are involved in evaluating the future effects of land management programs on various aspects of waterflow. The science of hydrology has not yet advanced to a point where completely satisfactory methods have been developed. Nevertheless, a plan for flood control or waterflow retardation is presented which is consistent with the present state of our knowledge and research.

Considerable benefits are assumed to accrue from the reduction in the rate of sediment accumulation in the authorized Whitlow Ranch reservoir proposed for construction by the Corps of Engineers. The report states that 7,000 acre-feet of space in the reservoir have been allocated to sediment storage which is assumed as adequate for

50 years. The procedures used in calculating the benefits derived from reduction of sedimentation appear to be satisfactory. However, the results are dependent upon the accuracy of the rates of sedimentation without the proposed program. If this rate is excessive and the life of Whitlow reservoir would exceed 50 years, then the estimated benefits are in excess of those which would actually accrue.

Retardation of waterflow by various control structures may provide increased opportunity for evaporation, and increased vegetative cover will increase transpiration losses, with the result that over-all water supplies may be reduced measurably. Few basic data are available regarding runoff and sediment loads. Additional data would afford better means for evaluating the effectiveness of the proposed land-range treatment and control structures. The program proposed by your Department would not interfere with plans of the Bureau of Reclamation except, possibly, for certain features of the potential central Arizona project. It is pleasing to note a statement in the report indicating that the Soil Conservation Service will coordinate its plans in this watershed with those of the Bureau of Reclamation. The program as outlined in the report, if put into operation, should benefit the Salt River project and the potential central Arizona project if and when constructed.

The report would, in our opinion, be improved by a description of the sampling techniques used in planning the watershed management program and engineering details and cost estimates for one of these typical proposed structures.

The Bureau of Land Management of this Department has jurisdiction over some land in all the subunits of the basin. Most of this land lies in the Bulldog and Superstition Mountain areas and as these lands may affect the program on the plains, some flood and erosion retardation work on the public lands may be necessary to supplement the work below. Because of the character of these lands the best means of improvement is to provide proper range management as an integral part of the general watershed protection program. The program proposed has the approval of the Bureau of Land Management of this Department.

The proposed program would, in general, benefit fish and wildlife resources of the basin. In view of the fact, however, that the report, of necessity, treats the program in a broad and general manner, it is difficult to anticipate to what degree individual features of the proposed plan would affect fish and wildlife. With this in mind, the Department recommends that the Fish and Wildlife Service and the Arizona Fish and Game Department be permitted to assist in the detailed planning for the program in order that means and measures, consistent with the primary purposes of the project, may be integrated into the proposed program to increase wildlife benefits.

The Bureau of Indian Affairs of this Department has no adverse criticism of the methods and analyses presented in the report. In their opinion, those making the survey have performed a thoughtful and careful job. The retard structure located on Indian lands is of interest to that Bureau. We understand that the Bureau of Indian Affairs has been assured on opportunity to participate in developing the design of the floodwater retard structure proposed to protect Indian lands and improvements. We also understand that the Bureau

of Indian Affairs or the Indians occupying the Gila River Indian Reservation will have no operation or maintenance obligations.

The Department feels that the proposed program will be beneficial provided that the floodways and retard structures affecting Indian lands will be operated and maintained to give proper protection to these lands and appurtenances. We appreciate the fact that the report has been coordinated with the Bureau of Reclamation of this Department with particular reference to certain features of the potential central Arizona project. This coordination should be continued should the proposed programs be authorized and work initiated. Finally, the Geological Survey would be pleased to collaborate with the Department of Agriculture in the consideration of such further studies or fundamental research as will contribute to more precise evaluations of the effectiveness of remedial measures proposed in this report.

Opportunity for review of the report is appreciated.

Sincerely yours,

WILLIAM E. WARNE,
Assistant Secretary of the Interior.

LETTER FROM DIRECTOR OF THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE TO THE SECRETARY OF AGRICULTURE

DEPARTMENT OF COMMERCE,
BUREAU OF FOREIGN AND DOMESTIC COMMERCE,
Washington 25, D. C., November 28, 1950.

The honorable the SECRETARY OF AGRICULTURE,
Washington 25, D. C.

DEAR MR. SECRETARY: We have reviewed the interim survey report on the Queen Creek watershed, Arizona, which you kindly submitted to us. While we have no specific comments to make on the program as outlined in this report, we are pleased to note that benefits have been calculated on a conservative projection of price levels.

Sincerely,

H. B. MCCOY, *Director.*

LETTER FROM THE CHAIRMAN OF THE FEDERAL POWER COMMISSION TO THE SECRETARY OF AGRICULTURE

FEDERAL POWER COMMISSION,
Washington 25, November 6, 1950.

Subject: Queen Creek watershed, Arizona.

Hon. CHARLES F. BRANNAN,
Secretary of Agriculture, Washington 25, D. C.

DEAR MR. SECRETARY: The comments herein with respect to your Department's survey report on the Queen Creek watershed, Arizona, are transmitted in response to your letter of September 6, 1950. The transmittal of these comments is in accordance with established procedures of the Federal Inter-Agency River Basin Committee.

The Queen Creek watershed is an isolated area within the Gila River Basin in Maricopa and Pinal Counties, Ariz., a few miles south-

east of Phoenix. There is no surface channel connecting the watershed with the Gila River. A number of small streams and washes drain the various mountain areas; all have intermittent flows and normally disappear into the desert floor before reaching the irrigated area at the western end of the basin.

The survey report recommends a program for runoff and waterflow retardation and soil-erosion prevention in the Queen Creek watershed, consisting of floodways and small diversion channels, a 4,000 acre-foot reservoir for temporary floodwater storage, stabilizing and sediment-control measures, and various land-treatment measures. The program would be developed during a 10-year period at an estimated total cost of $1,348,000, based on 1948 price levels. Of this amount, it is estimated that the Federal Government will expend $1,107,400 and local interests $240,600. The ratio of benefits to costs is estimated to be 2.1.

The Commission staff has reviewed the report of your Department, primarily with a view to determining whether the plan of improvement would affect existing or potential hydroelectric plants or offer any possibilities for hydroelectric power development. There are no existing hydroelectric power plants in the Queen Creek watershed and possibilities do not exist for the development of power in the basin due to the intermittent flow even during wet seasons and the common occurrence of droughts lasting for several years. The aforementioned measures, therefore, recommended in the survey report, have no direct connection with hydroelectric power development and offer no possibilities for such development.

The Commission appreciates the opportunity of reviewing and commenting on the report of your Department.

Sincerely yours,

MON C. WALLGREN, *Chairman.*

LETTER FROM THE ASSOCIATE CHIEF, BUREAU OF STATE SERVICES, PUBLIC HEALTH SERVICE TO THE ASSISTANT SECRETARY OF AGRICULTURE

FEDERAL SECURITY AGENCY,
PUBLIC HEALTH SERVICE,
Washington 25, D. C. October 26, 1950.

Mr. K. T. HUTCHINSON,
Assistant Secretary, Department of Agriculture,
Office of the Secretary, Washington 25, D. C.

DEAR MR. HUTCHINSON: Pursuant to the policies and procedures by the Federal Inter-Agency River Basin Committee, we have reviewed the report furnished by your Department entitled "Queen Creek Watershed, Arizona, July 1950 (Report of Appendixes)."

Due to time limitations a memorandum is not being submitted, although this will be the procedure in our review of future reports. We are hereby giving clearance to this report and are sending a copy of this letter to the Secretary of the Federal Inter-Agency River Basin Committee for his information.

Sincerely yours,

M. D. HOLLIS,
Assistant Surgeon General,
Associate Chief, Bureau of State Services.

SURVEY REPORT

QUEEN CREEK WATERSHED

ARIZONA

Program for Runoff and Waterflow Retardation and Soil Erosion Prevention

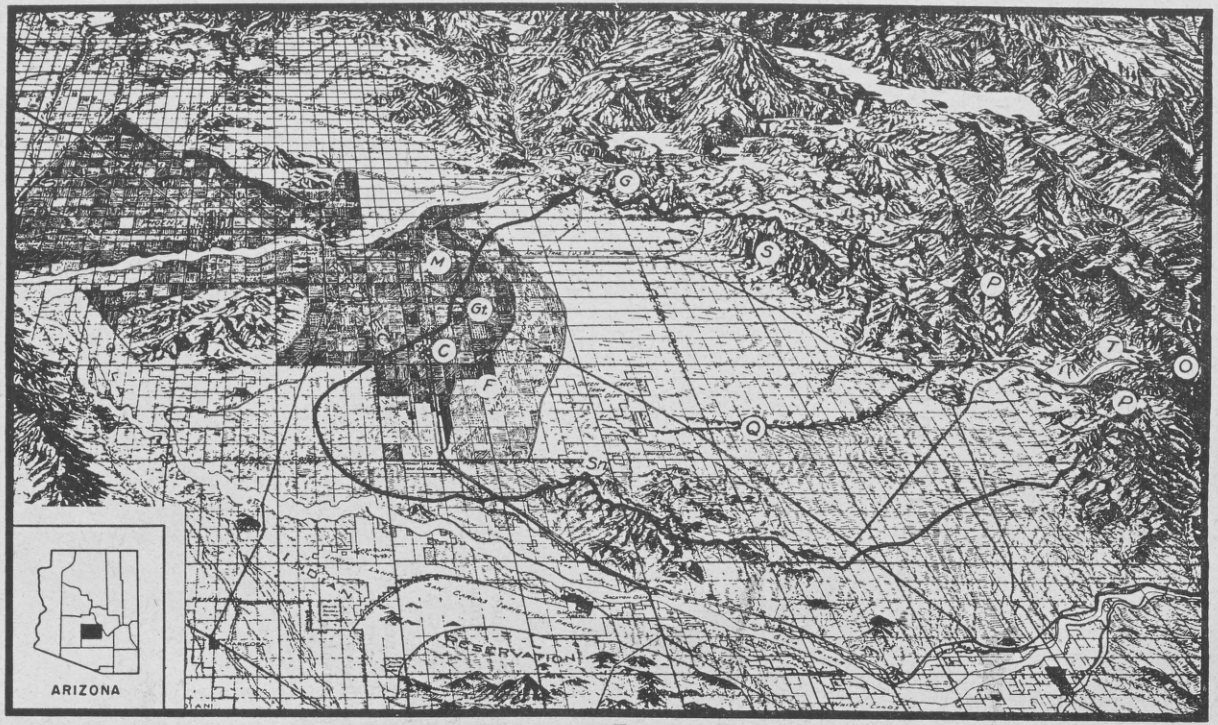
Pursuant to the Act approved June 22, 1936 (49 Stat. 1570), as amended and supplemented

U. S. DEPARTMENT OF AGRICULTURE

CONTENTS

APPENDIX CONTENTS

(This appendix is not printed in this document)



Scale: Each □ = 1 Square Mile

AFTER T.A.HAYDEN, PHOENIX, ARIZONA

Fig.1 - Queen Creek Watershed is the area bounded by the heavy solid line. F, Agricultural and flood-damage area. C, Chandler. Gt., Gilbert. M, Mesa. Q, Queen Creek. P, Pinal Mts. T, Superior. O, Oak Flat. S, Superstition Mts. G, Goldfield Mts. Sn., Santan Mtn. Flash flood flows sweep down from the mountain areas onto the agricultural and urban areas below. NOTE: Development of Agricultural Area East of Roosevelt Water Conservation District since 1938 not shown.

QUEEN CREEK WATERSHED, ARIZONA

INTRODUCTION

Authority.—This report is submitted under the provisions of the act approved June 22, 1936 (49 Stat. 1570), as amended and supplemented.

Purpose and scope of report.—The purpose of this report is to outline a program of runoff and waterflow retardation and soil erosion prevention for the Queen Creek watershed in Arizona, and to present recommendations for its installation and maintenance, together with an analysis of the costs and benefits thereof.

The Queen Creek watershed is drained internally by a number of independent streams, the principal of which is Queen Creek. The basin has an area of 880 square miles (563,200 acres), which lie between the Salt and Gila Rivers in Maricopa and Pinal Counties in southern Arizona (fig. 1). The Department of the Army, Corps of Engineers, has been authorized by the Congress to construct a flood control reservoir on Queen Creek which will reduce the flood damages normally caused by this stream. The program outlined in this report is concerned principally with the reduction of flood and sediment damages caused by drainages other than Queen Creek and that part of Queen Creek unaffected by the program of the Department of the Army.

RECOMMENDATIONS

It is recommended that a program of runoff and waterflow retardation and soil erosion prevention be installed during a 10-year period in the Queen Creek watershed in Arizona at an estimated cost of $1,107,400 to the Federal Government and at an estimated cost of $240,600 or its equivalent [1] to local interests, making an estimated total cost of $1,348,000 for the installation of the complete program.

Annual operation and maintenance costs are estimated at $20,290, of which local interests will provide $19,430 and the Federal Government the balance of $860.

The program herein recommended includes the intensification, acceleration, or adaptation of certain activities under the current programs of Federal agencies in the watershed, and additional measures not now regularly carried out in such programs, all of which are necessary to complete a balanced runoff and waterflow retardation and erosion-control program for the watershed. It is recommended that the Secretary of Agriculture be authorized to carry out all of this program except the part which is proposed for installation on land under the jurisdiction of a Federal agency other than the Department of Agriculture. It is further recommended that the head of such other Federal agency be authorized to carry out the part of

[1] Labor, materials, equipment, land, easements, rights-of-way, and other contributions in lieu of cash payments.

the program which is proposed for installation on land under the jurisdiction of such agency. Although the current activities of Federal agencies in the watershed which are primarily related to the objectives of the Flood Control Act are not included in the program herein specifically recommended, the program is based on the continuation of such activities at least at their present level.

The following recommended program for runoff and waterflow retardation and soil erosion prevention for the Queen Creek watershed is aimed at the reduction of floodwater and sediment damage, conservation of soil and water resources, and the establishment of a permanent and stable agriculture:

1. Construction of approximately 30 miles of minor floodways or relatively small diversions to collect and divert runoff water from plains areas to effective channels.
2. Construction of one floodwater retard structure to regulate runoff released from the system of floodways.
3. Construction of approximately 310 stabilizing and sediment control structures, including desilting areas.
4. Improvement of approximately 318,000 acres of range land.

Technical services will be made available for planning and applying the necessary land use adjustments, for planning and applying conservation measures on the watershed, and for integrating the measures included in the recommended program.

A portion of the cost of installing land treatment measures on non-Federal land will be provided in the form of direct aids.

Additional educational assistance will be made available to inform residents of the watershed regarding the type of program being recommended and to enlist the cooperation of various interests in carrying out the program.

The Secretary of Agriculture, or the head of any other Federal agency concerned, may construct such buildings and other improvements as are needed to carry out the measures included in the recommended program. In order to achieve the objectives of the recommended program, the Secretary of Agriculture or head of any other Federal agency concerned, may make such modifications or substitutions of the measures described herein as may be deemed necessary or advisable on account of changed physical or economic conditions or improved techniques.

The attainment of the flood-control benefits evaluated in this report is dependent upon the installation and proper maintenance of all phases of the recommended program.

The ratio of the average annual total benefit to the average annual value of the total cost of the recommended program is 2.1:1.

The recommended measures will be installed on non-Federal land under cooperative arrangements with individuals and with soil conservation districts, State and county governments, or other local agencies and committees empowered and in position to cooperate in carrying out the recommended program in a manner acceptable to the Secretary of Agriculture. This will include satisfactory assurance of their ability to meet the responsibilities for installing and operating and maintaining the recommended measures before such measures may be carried out.

The authority of the Secretary of Agriculture, or the head of any other Federal agency concerned, to prosecute the recommended pro-

gram shall be supplemental to all other authority vested in him, and nothing in this report shall be construed to limit the exercise of powers heretofore or hereafter conferred on him by law to carry out any of the measures described herein or any other measures that are similar or related to the measures described herein.

DESCRIPTION OF WATERSHED

Queen Creek watershed, which embraces about 880 square miles, is in Maricopa and Pinal Counties in southern Arizona (fig. 1). It lies immediately east of the confluence of the Salt and Gila Rivers and extends roughly from Chandler to Superior. The watershed is approximately 50 miles long and 25 miles wide, and includes approximately 10 percent of the most productive irrigated land in Arizona.

The watershed consists of a desert plain, the eastern extension of the irrigated Salt River Valley, which is bordered on the northeast and east by the Goldfield, Superstition, and Pinal Mountains and on the south by the lower Santan Mountains. A narrow foothill zone intervenes between this desert plain and the Pinal Mountains. On the southeast, the watershed is separated from the Gila River Valley by a low ridge. The southwestern boundary of the watershed is the natural levee along the north side of the Gila River. Elevations vary from 1,200 feet above sea level in the western part to Pinal Peak, elevation 7,850 feet above sea level.

The principal drainages are Queen Creek, Sand Tanks Wash, Buchanan Wash, Bulldog Wash, Sonoqui Wash, and Taylor Basin. These drainages are independent of each other in the mountains and foothills but during periods of high runoff some of the flows coalesce on the desert plain in the vicinity of the Roosevelt canal (fig. 1).

The streams flow in a southwesterly direction and are intermittent. The channels in the mountains are deep and have steep gradients. Below the mountains in the foothills and the desert plain, channel gradients become progressively flatter, and in the lower reaches, the channels are aggrading.

Soils in the higher elevations are generally less than 10 inches deep and in many areas rock occurs at the surface. In the foothills, compact and heavy textured soils are underlain by caliche at a depth of about 20 inches. The valley soils occurring on the desert plain are deep and medium to light textured. Erosion is serious on 28 percent of the watershed, moderate on 52 percent, and slight on 17 percent. On the remaining 3 percent, geologic erosion is dominant.

The vegetation on most of the watershed is deteriorated. Increased surface runoff has accelerated erosion and reduced soil moisture.

The average annual rainfall, based on Weather Bureau records, varies from 10 inches in the desert plain to 25 inches in the Pinal Mountains. Summer temperatures in the lower desert plain commonly exceed 100° F., and for the warmest month (July) have average maxima of 95° to 102°. In the same area, during the winter months, the minimum temperatures range from 34° to 39° (January). Cooler temperatures prevail in the mountains. In the agricultural area around Chandler and Gilbert, the average number of frost-free days is 290, and at Pinal Ranch in the mountain area, 161 days are frost-free.

The estimated population of the watershed in 1948 was 15,000, of which one-third lived in Superior, a mining town in the mountains. Two-thirds of the population reside on farms and in towns in the irrigated or flood-damage area west of the Roosevelt canal (fig. 1). About 80 percent of the watershed is devoted to grazing, 15 percent to irrigation farming, and the remaining 5 percent to mining and miscellaneous uses. The gross value of crops produced on 90,000 acres of irrigated land in 1948 is estimated at $10,000,000. During the same period about $100,000 worth of livestock and livestock products were produced from the range lands.

Thirty-eight percent of the land in the watershed is federally owned or administered, 26 percent State-owned, and 36 percent privately owned. Federally owned or administered land includes national forests (21 percent of watershed), other Federal lands (11 percent), and Indian lands (6 percent). Privately owned land includes land held by individuals under contract to purchase from the State of Arizona.

FLOOD PROBLEMS

Floods in the Queen Creek watershed cause damage to agricultural crops and land, irrigation systems, towns, roads, railroads, and utilities. During the 35-year period from 1914 through 1948, there have been 48 floods of varying magnitude. Since 1926, flood damages have amounted to a total of $2,800,000, or about $120,000 annually. This amount does not include the damage caused by Queen Creek proper, all of which has been evaluated by the Department of the Army, Corps of Engineers (H. Doc. 220, 80th Cong., 1st sess).

During the summer, intense storms of short duration occurring at or near the upper boundaries of the cultivated area may produce an instantaneous discharge of 3,000 to 6,000 cubic feet per second, which may cause breaks in the eastern dike of the Roosevelt canal. Similar storms occur in the foothills and mountains. Floodwater from these areas does not cause significant damage because the flood peaks are materially reduced before they reach the cultivated area, but it transports considerable sediment to the stream channels.

The less intense rains of longer duration produce runoff from all parts of the watershed sufficient to inundate highways and large acreages of farm land. Generally these 1-to-3-day rains produce greater quantities of runoff, but the resulting flood peaks are comparatively low except in Queen Creek proper.

Flood damages have been confined largely to agriculture and irrigation works and result from overtopping or failures in the eastern dike of the Roosevelt canal. The area of irrigated cropland inundated is dependent upon the location of the breaches in the dike. Most of the stream courses fan out before reaching the agricultural area. Floodwaters from these drainages accumulate at the Roosevelt canal, sometimes to a depth of several feet, and break into or over it or flow southward along its east bank.

When the canal banks are overtopped, the floodwaters flow in the irrigation laterals and along highways and roads and fan out as sheet flows over the level cropland. The flows range from swiftly flowing sheets a few inches deep and of a few hours duration on the steeper slopes to sluggish flows, 2 to 3 feet deep, which may remain on the flatter areas or against canal and railroad embankments for several

days. When the water reaches the eastern canal (fig. 1), it is deflected southward and dammed up until it breaks across this canal to fan out over the cropland to the west.

Based upon past flood and rainfall records, it is estimated that floods of sufficient magnitude to break through the eastern dike of the Roosevelt canal occur once in every 3 to 5 years. In 1936, a flood broke through the Roosevelt canal and caused farm damage in the amount of $284,000. In 1933, the town of Gilbert suffered flood damage in the amount of about $29,000.

Table 1 lists the monetary evaluation of the estimated average annual floodwater and sediment damage in the Queen Creek watershed, which does not include the damage that will be prevented by the works to be constructed by the Department of the Army, Corps of Engineers.

TABLE 1.—*Estimated average annual flood damage, Queen Creek watershed, Arizona* [1]

Type of damage:		
Agricultural damage:		
Crops and land	$91, 750	
Irrigation works	24, 850	
Subtotal		$116, 600
Nonagricultural damage:		
Highways and roads	$8, 100	
Urban and nonfarm property	7, 870	
Railroads and other utilities	1, 880	
Military bases	600	
Sedimentation in proposed Whitlow Ranch reservoir	17, 650	
Subtotal		36, 100
Total average annual damage		152, 700

[1] 1948 prices.

ACTIVITIES RELATED TO FLOOD CONTROL

Department of the Army, Corps of Engineers

The Congress has authorized the Department of the Army, Corps of Engineers, to construct a flood-control dam on Queen Creek at the Whitlow ranch site as recommended in House Document 220, Eightieth Congress, first session. The dam, when completed, will control runoff from approximately 143 square miles in the upper part of the Queen Creek watershed and will reduce flood damage caused by Queen Creek proper.

The Williams Air Force Base, Department of the Army, is developing plans to construct dikes north and east of the air base to provide flood protection.

United States Department of Agriculture

The Forest Service administers the Crook and Tonto National Forests, parts of which are located in the Queen Creek watershed. Watershed protection is a primary objective in the administration of these lands. Increasing attention is being given to fire control, proper grazing use, and improved woodland management.

The Soil Conservation Service provides four soil conservation districts in the watershed with technical assistance to carry out conserva-

tion programs. A small portion of this assistance is being utilized in planning and laying out low dikes to protect farm land.

The Production and Marketing Administration provides a part of the cost of establishing conservation practices on non-Federal range land in the Queen Creek watershed. These include fencing, stock-water developments, and spreader dams.

The Extension Service, cooperating with the State of Arizona, is carrying out an educational program in rural areas of the two counties located in the watershed. Included in this program is information which encourages the application of soil and moisture conservation practices.

The Farmers Home Administration administers a program of financial and technical assistance to farmers and ranchers. Assistance of this nature is available to farmers and ranchers in the Queen Creek Basin for establishing soil and moisture conservation practices.

The annual cost of the Department of Agriculture activities in the watershed which are related to flood control is estimated at $11,375.

United States Department of the Interior

The Bureau of Land Management administers about 60,000 acres of grazing land in the watershed. Ranchers who lease these lands are encouraged to use them in a manner which will improve existing forage resources and hold soil erosion to a minimum.

The Bureau of Indian Affairs maintains administrative direction of 1,500 acres of irrigated land and about 30,000 acres of range land in the Gila River Indian Reservation situated in the lower portion of the Queen Creek Basin. Consideration is given to the improvement of forage resources and the protection of farm lands from flood damage in administering these lands.

The Fish and Wildlife Service, cooperating with the State of Arizona, administers a program of predator and rodent control. These services are available in the Queen Creek Basin.

The annual cost of the Department of the Interior activities in the watershed which are related to flood control was not estimated since these activities consist largely of administering grazing land.

Soil and water conservation districts

The Roosevelt Water Conservation District constructed the Roosevelt canal in 1926. Since then, the eastern bank of this canal has been raised and a flood channel excavated along its upper side for a distance of about 12 miles from the southern end, in an attempt to reduce flood damage to the irrigated areas. In September 1946 a 1-mile channel was completed to carry floodwater from the southern end of the canal into the Gila River Indian Reservation, where it is released to spread over desert range land. The district has also realined about 2 miles of the Queen Creek Channel immediately above the canal. Notwithstanding the fact that between 1926 and 1948 approximately $115,000 was expended by the district for flood control, extensive flood damage still occurs.

Approximately 6½ miles of the Queen Creek Channel and 2 miles of Sonoqui Wash have been cleared of brush by landowners cooperating with the Queen Creek Soil Conservation District.

RECOMMENDED PROGRAM

A program of interrelated measures is recommended for the Queen Creek watershed. This program consists of minor floodways or diversions that will furnish direct and immediate protection to the high-damage areas in the lower part of the watershed and minor structural measures together with range-land improvements and adjustments in use that will function to assure permanence of the floodways at less cost for annual maintenance, extend the useful life of the proposed Whitlow Ranch Reservoir, and protect the watershed land from further deterioration.

Minor measures and range-land improvements and use adjustments together would provide some degree of protection to the high-damage areas but primarily during the small floods. Adequate flood protection in the watershed cannot be accomplished by these measures alone. The measures recommended in this report should be installed in the proper combination and sequence if the maximum benefit is to be obtained. They will be adapted wherever possible to improve wildlife resources in addition to serving their primary purpose.

The recommended program of runoff and waterflow retardation and soil-erosion prevention includes the following interrelated measures:

1. *Minor floodways (small diversions to collect and divert runoff water from plains areas to effective channels).*—Construction of a system of five floodways to provide immediate flood protection for agricultural and urban areas. These floodways will be designed to provide immediate and complete protection against floods up to 100-year frequency.

The first or northernmost floodway will be approximately 3.5 miles long and will intercept flood flows above the farming section in the northern portion of the watershed and divert them from the watershed into the Salt River. Outside the Queen Creek watershed, water will spill into an existing drainageway which crosses desert land and on which rights-of-way will be necessary. The present "overshot" passes water over the Salt River Valley Water Users' Association canal and will need to be enlarged to handle anticipated flood flows.

The second floodway will be approximately 11 miles long. It will collect floodwaters east of the farming area between the Mesa-Apache Junction Highway and Queen Creek and conduct them into an improved Queen Creek channel or third minor floodway. The exact location of this floodway will need to be determined in relation to the proposed central Arizona project of the Bureau of Reclamation.

The third minor floodway will involve the improvement of a portion of the Queen Creek channel through an irrigated area in the Queen Creek Soil Conservation District, in the southeast central part of the watershed. It will be approximately 7 miles long and will conduct floodwater to join with the fourth minor floodway approximately 3 miles northwest of Chandler Heights.

The fourth floodway will be approximately 4 miles long. It will connect with the lower end of the third floodway and follow generally southward above the Roosevelt Conservation District canal to the county line. At the county line this floodway will connect with a section of floodway recently completed by the Roosevelt Water

Conservation District to carry floodwater onto desert land in the Gila River Indian Reservation. This floodway on Indian lands will be enlarged to carry expected flood flows. Water will spread down the slope and will be intercepted by a floodwater retard structure described in the next section of the recommended program.

The fifth floodway will be approximately 4 miles long and will protect the Chandler Heights farming area against flood flows from the Santan Mountains.

The third floodway will involve the improvement of the present Queen Creek Channel. Other floodways will consist of earth dikes ranging in height from 6 to 8 feet with trapezoidal-shaped borrow sections approximately 150 feet across on the upstream side. The capacities of the floodways will vary from 6,000 to 12,000 cubic feet per second. All floodways except the first and second will be self-cleaning if annual growth and debris is removed. Only 80 percent of the sediment deposited in the first and second floodways will be removed since it is proposed to use the silt to heighten the dikes.

2. *Floodwater retard structure.*—A floodwater retard structure is recommended on Indian lands upstream from the Southern Pacific Railroad to control discharges from the proposed floodways to the extent required to prevent damage to existing farm lands, irrigation facilities, and roads on the Gila River Indian Reservation. The structure will consist of a reservoir formed by an earth dike about 2 miles long, ranging in height from 1 to 20 feet. It will have an ungated outlet.

3. *Stabilizing and sediment control structures.*—Construction of 300 to 350 stabilizing and sediment control structures and from 5,000 to 7,000 acres of fenced desilting areas to retard runoff, stabilize channels, arrest gully development, and control sediment.

Stabilizing and sediment control structures are proposed for the plains area to provide an immediate reduction in the amount of sediment that will enter the floodways and to permit the establishment and maintenance of a satisfactory vegetative cover that will become increasingly effective in reducing sediment movement. Most of these will consist of an earth diversion dam about 150 feet long and 6 feet high and spreaders to divert and spread runoff over 40 to 100 acres. Intensive treatment, including seeding and fencing, necessary on approximately 5,000 acres immediately above floodways, will require about 16 such measures per square mile; and extensive treatment, necessary on approximately 13,500 acres of range land, will require about 6 such measures per square mile. Approximately 600 acres of desilting area above the floodwater retard structure recommended will be fenced and seeded to grass.

Stabilizing and sediment control structures are also recommended above the Whitlow Ranch reservoir site to reduce sediment movement into the reservoir. These will include headcut drops, channel stabilizers, and other adaptable structures. Shrub plantings will be made in close proximity to the structures to add to their stability and effectiveness in holding back sediment.

4. *Other range land treatment.*—Improvement of approximately 318,000 acres of range land by establishing and maintaining vegetative cover to retard runoff and control erosion. This will be done by seeding grass on 13,500 acres on the plains area, planting grass and shrubs on 5,000 acres above the Whitlow Ranch reservoir site, constructing

approximately 105 miles of fence to bring about more conservative range use, and otherwise aiding in carrying out improved land management practices.

COST OF THE RECOMMENDED PROGRAM

The estimated cost of installing the recommended program for the Queen Creek watershed is shown in table 2.

TABLE 2.—*Estimated cost of installing the recommended program (1948 prices), Queen Creek watershed, Arizona*

Measures	Unit	Approximate number	Cost
Floodways (diversions)	Miles	30	[1] $784,000
Floodwater retard structure	Each	1	[2] 168,000
Land treatment measures	Acres	318,000	[3] 396,000
Total installation cost			[4] 1,348,000

[1] Includes the cost of stabilizing and sediment control structures and seeding and fencing desilting areas immediately above floodways. Also includes engineering and work plan development costs.
[2] Includes the cost of seeding and fencing the desilting area above the retard structure. Also includes engineering and work plan development costs.
[3] Includes cost of stabilizing and sediment control structures, fencing, grass seeding, and other revegetation on range land. Also includes cost of technical services and educational assistance.
[4] Approximately 4 percent of this amount is for technical services and educational assistance.

The estimated sharing of costs is based upon the recommendation that—

The Federal Government will bear the cost of constructing the floodways and floodwater retard structure, and stabilizing and sediment-control measures, together with the seeding and fencing of desilting areas associated with the floodways and retard structure. Local interests will bear the cost of all easements and rights-of-way. The Federal Government will bear the entire cost of installing land-treatment measures on federally owned or administered land and will provide direct aids to cover a portion of the cost of installing land-treatment measures on non-Federal land. Land-treatment measures will be installed on non-Federal land with assistance in the form of direct aids and technical services. The Federal Goverment will furnish the technical services needed to apply the recommended land-treatment measures and to integrate them with related flood-control measures. In cooperation with the State of Arizona the Federal Government will also provide educational assistance to secure widespread understanding and acceptance of the recommended program.

A local agency or agencies acceptable to the Secretary of Agriculture will expend an estimated $17,860, or its equivalent, annually for operation and maintenance of the floodways, floodwater retard structure, and associated stabilizing and sediment-control measures. Local interests will be expected to maintain land-treatment measures installed on non-Federal range land at an estimated annual cost of $1,570. Land-treatment measures installed on federally owned or administered land will be maintained by the Federal Government at an estimated cost of $860 annually.

The distribution of the annual cost, based on 1948 prices, is as follows:

	Installation cost	Annual maintenance cost	Equivalent average annual cost
Federal	$27,685	$860	$28,545
Non-Federal	7,687	19,430	27,117
Total	35,372	20,290	55,662

In converting installation cost to average annual cost, 2½ and 4 percent interest rates were used for public and private costs respectively.

MONETARY BENEFITS FROM THE RECOMMENDED PROGRAM

Benefits from the recommended program will accrue to farming, ranching, business, and the consuming public. The flood-control survey of the Queen Creek watershed reveals that the installation of a coordinated program of runoff and waterflow retardation and soil-erosion prevention will yield benefits in excess of its cost.

Intangible benefits were not evaluated for the purposes of this report. The most important benefits of this type are the prevention of interruptions in transportation and communication services and in the operation of national defense establishments. Other unevaluated benefits which will accrue from the program are the elimination of unsanitary conditions due to floods, the improvement of wildlife habitat and recreational values, and the creation of a feeling of greater security on the part of individuals living in the watershed.

The estimated average annual benefits resulting from the recommended program for the Queen Creek watershed are shown in table 3.

COMPARISON OF BENEFITS AND COSTS

Based on prices and costs expected to prevail under intermediate employment levels during the period 1955–65, the ratio of the average annual benefit ($88,670) to the average annual cost ($42,780) is 2.1:1.

TABLE 3.—*Estimated average annual monetary benefits from the recommended program (1948 prices), Queen Creek watershed, Arizona*

Reduction in agricultural damage:	
Crops and land	$91,750
Irrigation works	24,850
Subtotal	116,600
Reduction in nonagricultural damage:	
Highways and roads	8,100
Urban and nonfarm property	7,870
Railroads and other utilities	1,880
Military bases	600
Sedimentation of proposed Whitlow Ranch reservoir	5,260
Subtotal	23,710
Other benefits:	
Beneficial use of floodwater	2,950
Increased forage production	8,400
Subtotal	11,350
Total average annual benefit	151,660

○